

CLAIMS

1. An encapsulating epoxy resin molding material, comprising
5 (A) an epoxy resin, (B) a curing agent, and (C) an inorganic
filler,

wherein the inorganic filler (C) has an average particle
size of 12 μm or less and a specific surface area of 3.0 m^2/g
or more.

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2. An encapsulating epoxy resin molding material, comprising
(A) an epoxy resin, (B) a curing agent, and (C) an inorganic
filler,

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wherein the inorganic filler (C) comprises 5% or more by
weight of an inorganic filler having a maximum particle size
of 63 μm or less and particle sizes of 20 μm or more.

3. An encapsulating epoxy resin molding material, comprising
(A) an epoxy resin, (B) a curing agent, and (C) an inorganic
20 filler,

the inorganic filler (C) having an average particle size
of 15 μm or less and a specific surface area of 3.0 to 6.0 m^2/g ,
and the molding material used in a semiconductor device having
one or more of the following structures (a1) to (d1):

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(a1) a structure wherein a bump height of a flip chip is
150 μm or less,

(b1) a structure wherein a bump pitch of the flip chip

is 500 μm or less,

(c1) a structure wherein an area of a semiconductor chip is 25 mm^2 or more, and

(d1) a structure wherein a thickness of a package, in which
5 the semiconductor chip is disposed on a mounting substrate, is 2 mm or less.

4. An encapsulating epoxy resin molding material, comprising
(A) an epoxy resin, (B) a curing agent, and (C) an inorganic
10 filler, and satisfying at least one of the following conditions:
the glass transition temperature based on TMA method is 150°C
or higher; the bending modulus based on JIS-K 6911 is 19 GPa
or less; and the mold shrinkage ratio based on JIS-K 6911 is
0.2% or less.

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5. The encapsulating epoxy resin molding material according
to any one of claims 1 to 4, wherein the melt density of the
epoxy resin (A) is 2 poises or less at 150°C.

20 6. The encapsulating epoxy resin molding material according
to any one of claims 1 to 4, wherein the epoxy resin (A) comprises
at least one of a biphenyl epoxy resin, a bisphenol F epoxy resin,
a styrene epoxy resin, a sulfur-containing epoxy resin, a
Novolak epoxy resin, a dicyclopentadiene epoxy resin, a
25 naphthalene epoxy resin and a triphenylmethane epoxy resin.

7. The encapsulating epoxy resin molding material according

to any one of claims 1 to 4, wherein the melt density of the curing agent (B) is 2 poises or less at 150°C.

8. The encapsulating epoxy resin molding material according
5 to any one of claim 1 to 4, wherein the curing agent (B) comprises at least one of a biphenyl phenol resin, an aralkyl phenol resin, a dicyclopentadiene phenol resin, a triphenylmethane phenol resin, and a Novolak phenol resin.

10 9. The encapsulating epoxy resin molding material according to any one of claims 1 to 4, further comprising a curing accelerator (F).

15 10. The encapsulating epoxy resin molding material according to claim 1, wherein the inorganic filler (C) satisfies at least one of the following conditions: the amount of particles having a particle size of 12 μm or less is 50% or more by weight; the amount of particles having a particle size of 24 μm or less is 70% or more by weight; and the amount of particles having a particle
20 size of 32 μm or less is 80% or more by weight; and the amount of particles having a particle size of 48 μm or less is 90% or more by weight.

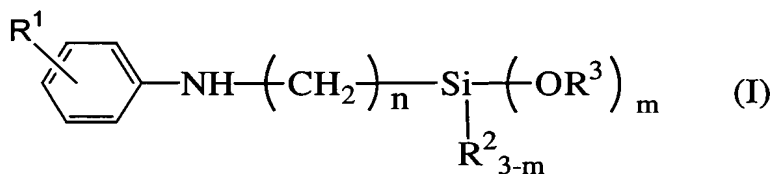
25 11. The encapsulating epoxy resin molding material according to any one of claims 1 to 3, wherein the average particle size of the inorganic filler (C) is 10 μm or less.

12. The encapsulating epoxy resin molding material according to any one of claims 1 to 3, wherein the specific surface area of the inorganic filler (C) is from 3.5 to 5.5 m²/g.

5 13. The encapsulating epoxy resin molding material according to any one of claims 1 to 4, further comprising a coupling agent (D).

14. The encapsulating epoxy resin molding material according to claim 13, wherein the coupling agent (D) comprises (D2) a
10 silane coupling agent having a secondary amino group.

15. The encapsulating epoxy resin molding material according to claim 14, wherein the silane coupling agent (D2), which has the secondary amino group, comprises a compound represented by
15 the following general formula (I):



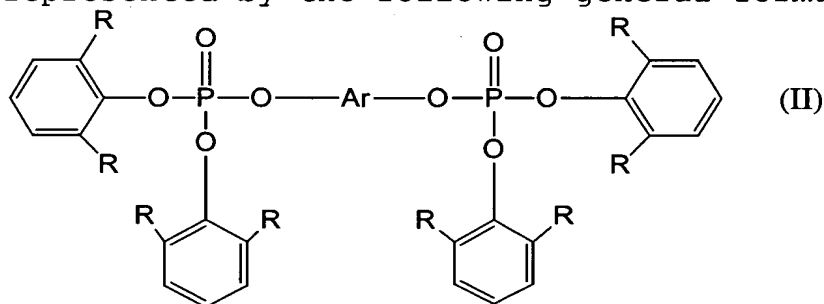
wherein R¹ is selected from a hydrogen atom, an alkyl group having
20 1 to 6 carbon atoms, and an alkoxy group having 1 to 2 carbon atoms, R² is selected from an alkyl group having 1 to 6, and a phenyl group, R³ represents a methyl or ethyl group, n represents an integer of 1 to 6, and m represents an integer of 1 to 3.

25 16. The encapsulating epoxy resin molding material according

to any one of claims 1 to 4, further comprising a phosphorus compound (E) .

17. The encapsulating epoxy resin molding material according
5 to claim 16, wherein the phosphorus compound (E) comprises a phosphate.

18. The encapsulating epoxy resin molding material according
to claim 17, wherein the phosphate comprises a compound
10 represented by the following general formula (II):



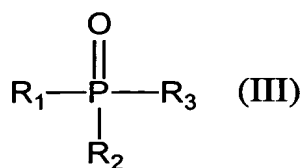
wherein eight R's, which may be the same or different, each represent an alkyl group having 1 to 4, and Ar represents an aromatic ring.

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19. The encapsulating epoxy resin molding material according
to claim 16, wherein the phosphorus compound (E) comprises
phosphine oxide.

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20. The encapsulating epoxy resin molding material according
to claim 19, wherein the phosphine oxide comprises a compound
represented by the following general formula (III):



wherein R¹, R² and R³, which may be the same or different, each represent a substituted or unsubstituted alkyl group having 1 to 10 carbon atoms, an aryl group, an aralkyl group, or a hydrogen atom provided that the case that all of R¹, R² and R³ are hydrogen atoms is excluded.

21. The encapsulating epoxy resin molding material according to any one of claims 1 to 3, which has one or more of the following structures (a1) to (f1):

(a1) a structure wherein a bump height of a flip chip is 150 μm or less,

(b1) a structure wherein a bump pitch of the flip chip is 500 μm or less,

(c1) a structure wherein an area of a semiconductor chip is 25 mm² or more,

(d1) a structure wherein a thickness of a package, in which the semiconductor chip is disposed on a mounting substrate, is 2 mm or less,

(e1) a structure wherein the flip chip has 100 or more bumps, and

(f1) a structure wherein a thickness of an air vent when the material is molded is 40 μm or less.

22. The encapsulating epoxy resin molding material according to any one of claims 1 to 3, which has one or more of the following structures (a2) to (f2):

5 (a2) a structure wherein a bump height of a flip chip is 100 μm or less,

(b2) a structure wherein a bump pitch of the flip chip is 400 μm or less,

(c2) a structure wherein an area of a semiconductor chip is 50 mm^2 or more,

10 (d2) a structure wherein a thickness of a package, in which the semiconductor chip is disposed on a mounting substrate, is 1.5 mm or less,

(e2) a structure wherein the flip chip has 150 or more bumps, and

15 (f2) a structure wherein a thickness of an air vent when the material is molded is 30 μm or less.

23. The encapsulating epoxy resin molding material according to claim 13, wherein the filler coverage ratio of the coupling agent (D) is from 0.3 to 1.0.

24. The encapsulating epoxy resin molding material according to claim 13, wherein the heating reduction ratio after heating at 200°C/hour is 0.25% or less by weight.

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25. The encapsulating epoxy resin molding material according to claim 23, wherein the heating reduction ratio after heating

at 200°C/hour is 0.25% or less by weight.

26. The encapsulating epoxy resin molding material according to claim 4, wherein the epoxy resin molding material is applied
5 to a semiconductor device having one or more of the following structures (c1), (d1) and (g1):

(c1) a structure wherein an area of a semiconductor chip is 25 mm² or more,

(d1) a structure wherein a thickness of a package, in which
10 the semiconductor chip is disposed on a mounting substrate, is 2 mm or less, and

(g1) a structure wherein the encapsulating-material molded area based on a package-molding method is 3000 mm² or more.

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27. The encapsulating epoxy resin molding material according to claim 4, wherein the epoxy resin molding material is applied to a semiconductor device having one or more of the following structures (c2), (d2) and (g2):

20 (c2) a structure wherein an area of a semiconductor chip is 50 mm² or more,

(d2) a structure wherein a thickness of a package, in which the semiconductor chip is disposed on a mounting substrate, is 1.5 mm or less, and

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(g2) a structure wherein the encapsulating-material molded area based on a package-molding method is 5000 mm² or more.

28. The encapsulating epoxy resin molding material according to claim 4, wherein the warp of a semiconductor device is 5.0 mm or less.

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29. The encapsulating epoxy resin molding material according to claim 4, wherein the warp of a semiconductor device is 2.0 mm or less.

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30. The encapsulating epoxy resin molding material according to claim 4, wherein the content by percentage of the inorganic filler (C) is from 70 to 90% by weight of the epoxy resin molding material.

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31. A semiconductor device encapsulated by an encapsulating epoxy resin molding material comprising (A) an epoxy resin, (B) a curing agent, and (C) an inorganic filler.

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32. The semiconductor device according to claim 29, including one or more of the following structures (a1) to (f1):

(a1) a structure wherein a bump height of a flip chip is 150 μm or less,

(b1) a structure wherein a bump pitch of the flip chip is 500 μm or less,

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(c1) a structure wherein an area of a semiconductor chip is 25 mm^2 or more,

(d1) a structure wherein a thickness of a package, in which

the semiconductor chip is disposed on a mounting substrate, is 2 mm or less,

(e1) a structure wherein the flip chip has 100 or more bumps, and

5 (f1) a structure wherein a thickness of an air vent when the material is molded is 40 μm or less.

33. The semiconductor device according to claim 29, including one or more of the following structures (a2) to (f2):

10 (a2) a structure wherein a bump height of a flip chip is 100 μm or less,

(b2) a structure wherein a bump pitch of the flip chip is 400 μm or less,

(c2) a structure wherein an area of a semiconductor chip
15 is 50 mm^2 or more,

(d2) a structure wherein a thickness of a package, in which the semiconductor chip is disposed on a mounting substrate, is 1.5 mm or less,

(e2) a structure wherein the flip chip has 150 or more
20 bumps, and

(f2) a structure wherein a thickness of an air vent when the material is molded is 30 μm or less.

34. The semiconductor device according to claim 29, including
25 one or more of the following structures (c1), (d1) and (g1):

(c1) a structure wherein an area of a semiconductor chip is 25 mm^2 or more,

(d1) a structure wherein a thickness of a package, in which the semiconductor chip is disposed on a mounting substrate, is 2 mm or less, and

(g1) a structure wherein the encapsulating-material
5 molded area based on a package-molding method is 3000 mm² or more.

35. The semiconductor device according to claim 29, including one or more of the following structures (c2), (d2) and (g2):

10 (c2) a structure wherein an area of a semiconductor chip is 50 mm² or more,

(d2) a structure wherein a thickness of a package, in which the semiconductor chip is disposed on a mounting substrate, is 1.5 mm or less, and

15 (g2) a structure wherein the encapsulating-material molded area based on a package-molding method is 5000 mm² or more.